THE DOUBLE 48-INCH MANIFOLD AT BISSELL'S POINT, ST. LOUIS

By C. M. Daily

A brief history of the St. Louis water works will be given, to enable the reader to understand the changing and growing conditions leading up to the present state of affairs which requires flexibility in the pumping from no. 2 engine house at Bissell's Point. To obtain the desired flexibility a chamber containing a double 48-inch manifold is now under construction about 129 feet west of no. 2 pumping station.

In the history of the St. Louis water works, the four years between 1867 and 1871 formed a constructive period, during which time was built the new pumping station at Bissell's Point, consisting of an intake tower, settling basins, low-service pumping station, clear well and no. 1 high service station. During this same period the standpipe on Grand Avenue and Compton Hill Reservoir were constructed.

In 1884 a second standpipe at Blair Avenue and Bissell's Avenue and the second high-service station at Bissell's Point were built. Another construction period was from 1887 to 1895; during this time an intake tower, tunnel, low-service pumping station and six settling basins were constructed at the Chain of Rocks and a 9- to 11-foot brick conduit connecting the settling basins at the Chain of Rocks with the settling basins at Bissell's Point, having a total length of 7 miles, were built. A third high-service station was constructed at Baden, 3.4 miles north of Bissell's Point, in 1898, and in 1905 a storage reservoir at Baden and a 7-foot steel flow line connecting with the settling basins at the Chain of Rocks were built.

After the low-service station at the Chain of Rocks was in use the intake tower and the old low-service station at Bissell's Point were abandoned, the settling basins becoming storage reservoirs. The three high-service stations received their supply of water from the Chain of Rocks by gravity flow through a 11-foot brick conduit and a 7-foot steel pipe to Baden and through a 9-foot brick conduit from Baden to Bissell's Point. The loss of head was about 1 foot in 10,000.

The high-service stations at Bissell's Point carried 85 pounds pressure per square inch and supplied the lower sections of the city, Compton Hill storage reservoir floating on the line. Baden high-service station carries 125 pound pressure per square inch and supplies the higher portions of the city. A standpipe at Compton Hill, erected in 1899, is connected to the Baden line.

From time to time additional equipments were added to the three high-service stations until 1911, when it became necessary to increase the capacity of both the Baden and Bissell's Point service. At this time the stations were equipped as follows: At Baden there were six triple expansion crank-and-fly-wheel engines four of which are rated at 15,000,000 gallons per day, and two at 10,000,000 gallons per day, the continuous working capacity being about 50,000,000 gallons. At Bissell's Point station no. 1 there were three triple expansion crank-and-fly-wheel engines having a continuous working capacity not exceeding 38,000,000 gallons per day. At station no. 2 there were three walking-beam engines built between 1884 and 1887, each having a nominal capacity of 16,000,000 gallons per day, the continuous working capacity not exceeding 30,000,000 gallons.

The problem presenting itself in the Water Department at that time was to increase the output of both Baden and Bissell's Point service to meet the increasing demands. To increase the capacity of Baden station it would have been necessary to build an additional engine house and a long 36-inch service main to reach the center of the distributing area. At Bissell's Point station no. 2 the fact that the engines had a very low efficiency (about 65,000,000 foot pounds per 1000 pounds of steam) justified their replacement. The distance to the center of the high pressure distribution area being closer, requiring a shorter and therefore cheaper 36-inch main, the loss of head in the conduit being much less than in the 36-inch pipe made it more economical to pump from Bissell's Point, except in the northern and north-western part of the city, than from Baden. It was, therefore, proper from an economical standpoint to increase Bissell's Point station no. 2 rather than Baden station. The final decision was to change Bissell's Point station no. 2 to work on both the Baden service and the Bissell's Point service.

To carry out this plan the three old engines were removed and two 20,000,000 gallon Holly triple-expansion crank-and-fly-wheel engines were installed in 1913 and one 20,000,000 gallon centrifugal pump was installed in 1915. The three pumps were designed to work either on

Baden or Bissell's Point service. The three 36-inch discharge pipes from this station were used for the new engines; one of these 36-inch mains was connected to the Baden service near Grand Avenue tower and the other two mains remained on Bissell's Point service.

The plan to install two more 20,000,000 gallon engines in this station would require extending the present by-pass arrangement far beyond its present limits in order to maintain the desired flexibility of pumping. This would require more space than there is available for the purpose. After various schemes were proposed and studied, it was decided to make the necessary by-pass connections through a double 48-inch cast iron manifold, to be built in a reinforced concrete chamber located 129 feet west of no. 2 station.

The manifold is designed to accommodate five engines, as a maximum, pumping into either Baden or Bissell's Point service with any engine. It is composed of two parallel 48-inch flanged cast iron pipes 94 feet long, spaced 12 feet apart in a vertical plane and erected at right angles to the 36-inch mains from the pumping station. The Baden service mains connect to the upper manifold and the Bissell's Point service mains to the lower.

Each main from the station will be connected to both upper and lower manifold in a vertical plane by means of a Y-branch introduced into the main about 20 feet east of the manifold. Each branch of each main will have a hydraulic-operated gate valve inside the concrete chamber. These valves will be operated from the station, permitting the engineer to pump, at will, into the 85-pound or 125-pound service mains.

Three hand-operated and two hydraulic 36-inch valves are placed on the service mains leaving the manifold and four hand-operated 48-inch valves placed in the manifold are for the purpose of withdrawing part of the system for any necessary repairs or inspection. The manifold is designed for connecting five service mains; four mains are now in place. The present plan is to use the two central mains for Bissell's Point service and the north main for Baden service: the south main, being the new 36-inch steel line, for both Bissell's Point and Baden service, the by-pass valves for this purpose being located at a distant point.

The manifolds are supported on steel I beams, incased in concrete for protection, which rest on the side walls of the chamber. The chamber, whose top will be flush with the ground at the center, is 102 feet long, 20 feet, 4 inches wide and 18 feet, 8 inches deep, all inside

dimensions. The bottom is designed to distribute the weight of the chamber and manifold over the entire area, the side walls to act as a vertical beam designed to withstand water pressure on the outside or one-half that pressure on the inside; horizontal beams at the top of the wall transfer the reaction of the wall to struts or ties across top. The struts or tie beams act also as roof girders, on which rest removable reinforced roof beams which support the removable roof slab. The roof slabs are 5 feet, 8 inches by 5 feet, 2½ inches and 4 inches. thick and are provided with openings for eyebolt connections for use in handling. The bottom of the chamber is lower than the sewers in its locality, and the drainage is effected by laying a 12-inch cast iron pipe to the sump in the engine house, where the water may be collected and pumped into the sewer.

Actual work on the chamber was started March 25, 1918. The present plan is to make the excavation and build about 44 feet of the south end of the chamber without removing the mains within this area. The reason for this procedure is that the ground-water level varies with the stage of the Mississippi River, and should the river rise above 20 feet on the St. Louis gauge it would be impracticable, if not impossible, to unwater the completed excavation without incurring heavy expense. Another reason is a possibility of not being able to get all of the castings for the manifold before the demand on the pumping reaches a high point. As a matter of safety it was thought best not to cripple this pumping station by removing any part of the old mains until it was certain there would be no delay in immediately rebuilding the new permanent mains. The second step involves the removal of the old mains in the next section of 24 feet and building the chamber and manifold complete for this distance. The third step will involve the removal of the two north mains and the construction of the remainder of the chamber and manifold. Temporary connection may be made from no. 6 pump to the completed portion of the manifold, before the last step in the construction is started, should the demand on the station at the time warrant it being done.

As simple as the construction appears from the description given, the work is viewed by the Engineering Department as a difficult operation, due chiefly to the soft treacherous ground which must support the adjacent 36-inch cast iron mains under working pressure while the excavation is being made and the reinforced concrete manifold chamber is under construction.

The excavation is being made with a clam shell. The material is dumped into flat cars and transported by electric cars to points on the Water Works property where a fill is required, and unloaded by hand. The excavation is lined solidly with 2-inch lumber and braced across the pit. The mains encountered in the excavation are supported by columns changed from time to time in order to keep their footings well below the bottom of the excavation. The ground water is removed by a 4-inch pulsometer. So far very little trouble has been experienced in the construction, The work is being done by employees of the Water Department under the author's direction, Mr. John Allgeyer acting as superintendent of the work.

The estimated cost of the work is $74,000, divided among the various items entering into its construction as follows:

Cast iron pipe, fittings, valves, etc.	$49,620.00
12 inch cast iron drains	812.00
Excavation, shoring, pumping, bracing and back-fill 2000 cubic feet at $2.00	4,000.00
Concrete, 615 cubic yards at $12.75	7,841.00
Removing mains, relaying and connecting manifold	5,000.00
Miscellaneous work, 10 per cent	6,727.00
	$74,000.00